Transport Independent OAM Multi-Layer (TIME) Problem Statement & Activity, IETF Toronto July20,2014

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Discussion of TIME

- Transport Independent OAM Multi-Layer (TIME)
  - Generic and integrated OAM with a focus of multi-layer and cross-layer considerations.
- TIME Scope discussed in Problem Statement and Use Case I-D
  - http://tools.ietf.org/html/draft-ww-opsawg-multi-layer-oam-02
  - http://tools.ietf.org/html/draft-king-opsawg-time-multi-layer-oam-use-case-01
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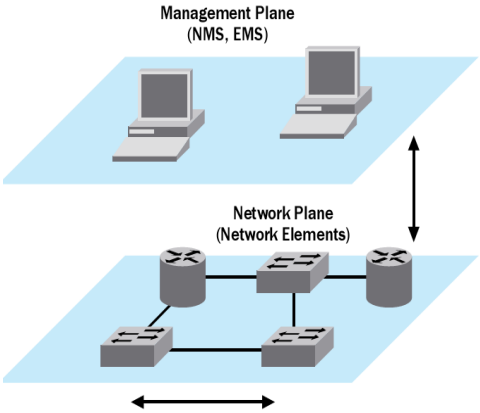
  - **Varun Singh**

Background

- Typically OAM protocols can not work without provision(e.g., initial bootstrap of OAM).
  - OAM protocol is usually in-band data plane protocols
    - OAM contain a group of network management function for service diagnose, troubleshooting, trigger repair.
  - Provisioning requires management plane protocols
    - Used to configure the network to provide OAM services



- To date, a variety of OAM tools across Standards Development Organizations (SDOs) have been developed for OTN,SDH,Ethernet, MPLS and IP networks.
  - Each technology, used at specific layer, has a specific and best suited set of OAM tools.

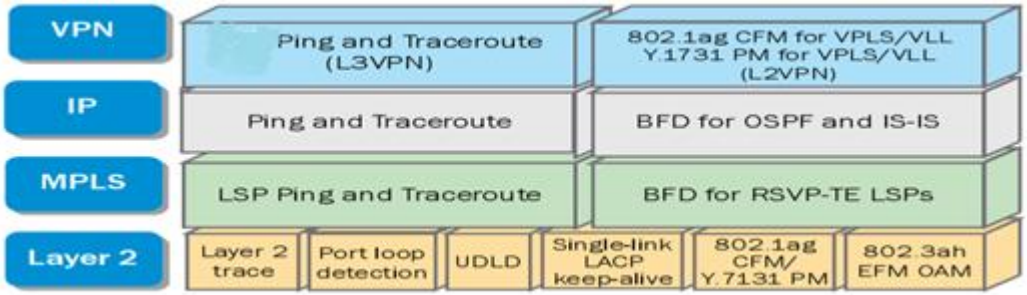


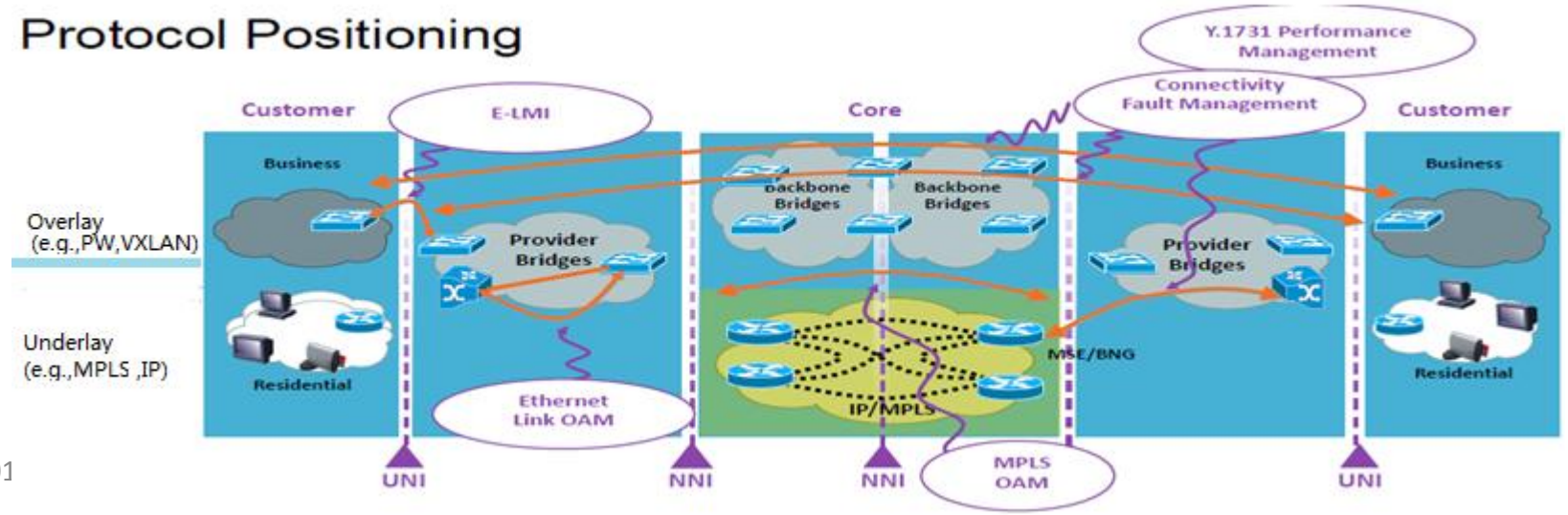
Figure1

The Problem

- Networks require a set of disparate OAM tools
  - Each domain (technology, layer, administrative region) has its best suited OAM tools.
    - Some have rich functionality (e.g., Y.1731)
    - Others provide specific function in unique protocol (e.g., MPLS OAM, MPLS-TP OAM, Pseudowire OAM)
- Layer 1/2/3 OAM protocols developed at MPLS OAM are applied to overlay networks(NVO3,SFC,EVPN…) - different encapsulation (VXLAN, NVGRE,GPE,GUE) make it difficult:
  - Different Overlay encapsulation may use different OAM protocol on same functionality.
  - No mechanisms to exchange performance and liveliness information between the underlay and overlay(s) by coordination system
  - The OAM in the underlay may not reflect OAM issue in the overlay
  - Existing layer OAM protocol with some adaptation may be not sufficient

The Problem

- If we split the network is split into Customer, Edge , and Core:
  - MEF E-LMI - User to Network Interface (UNI)
  - IEEE Link OAM - Any point-to-point 802.3 link
  - IEEE CFM / ITU-T Y.1731 - End-to-End UNI to UNI
  - MPLS OAM, PW OAM,IETF BFD, RSVP-TE OAM - within MPLS cloud



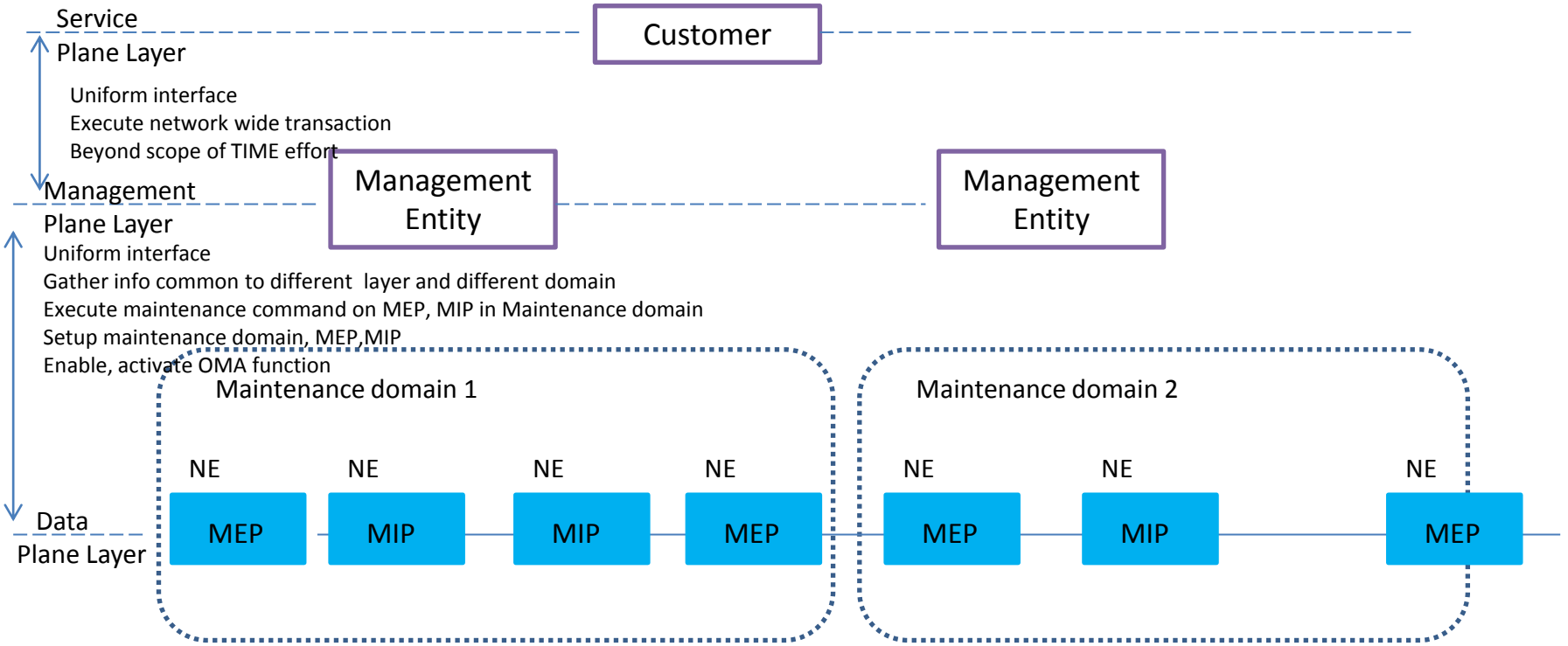
Strong Technology Dependencies

- OAM mechanisms are usually oriented to a single network technology or a single layer.
  - ICMP, LSP Ping provide the same OAM functionality, i.e., Path Discovery but use different network technologies.
  - BFD,LSP Ping provide the same functionality (i.e., Continuity Check) but use different network technologies.

RFC7276 Table 4: Summary of the OAM Functionality in IETF OAM Tools

Toolset	Continuity Check	Connectivity Verification	Path Discovery	Perf. Monitoring	Other Functions
IP Ping	Echo				
IP Traceroute			Traceroute		
BFD	BFD Control/Echo	BFD Control			RDI Using BFD Control
MPLS OAM(LSP Ping)		"Ping"mode	"Trace route"mode		
MPLS-TP OAM	cc	Cv/Proactive or on demand	Route Tracing	-LM -DM	-Diagnostic Test -Lock Alarm Reporting -Client Failure Indication -RDI
Pseudowire OAM	BFD	-BFD -ICMP Ping -LSP Ping	LSP Ping		
OWAMP and TWAMP	-Control Protocol			-DM -LM	
TRILL OAM	CC	CV	Path Tracing	-DM -LM	

Layering OAM architecture in management plane



NE - Network Element
MEP – Maintenance Endpoint
MIP - Maintenance Intermediary Point
MD - Maintenance Domain

Weakness of Cross-Layer OAM

- Cross layer OAM is important in NO3 and SFC work
  - Need to Stitching OAM at different layer using different encapsulation
  - Currently no end to end OAM visibility.
- RFC7276 (Overview of OAM) states the following OAM restrictions for multi-layer:
  - OAM message should not cross layers
  - OAM message should not leak outside domain boundaries within a layer

- RFC7276 does not discuss inter-layer OAM operations
  - How would different OAM in the data plane interact through management plane via unified management interface?
  - integration of OAM across multiple technologies is extremely difficult
  - MPLS-TP has done for link, but nothing done for overlay networks.

Lack of OAM above Layer 3

- Layer 1/2/3 OAM protocols offer rich functionality, standardized (well defined) and heavily used.
- OAM Mechanisms for technologies above Layer 3 have not been defined or developed yet, candidate solutions include:
  - Out of band OAM or control plane OAM(e.g., RSVP-TE)
  - BFD
  - Generic Protocol header
  - Generic TLV extension
- For instance, Service Function Chain, There is no OAM to be defined at the top of layer 3 for service function right now.
  - A Service Function Chaining is composed by a series of service Functions, that can act in different layers but providing an end-to-end chain or path from a source to destination in a given order.
  - How to exchange OAM between service functions in different layers while using various encapsulating protocols?

Issues of Abstraction (1)

- OAM functions are enabled at different layers and various OAM information needs to be gathered from various layers
- How would the management plane consolidate OAM information in different layers, and even different administration region or operators?
  - Management applications must understand (context and function) what information at different part of network using differenet layer OAM protocol stands for.
  - Need to gather and abstract OAM information that are common to different layers through a common interface, regardless of underlying data plane protocol
  - Need to correlate OAM information from different part of network by using management plane entity
  - Need to enable and active OAM function in different domain through unified management interface

Issues of Abstraction (2)

- Covering Heterogeneous Network Technologies or overlay technologies(e.g., VXLAN, NVGRE, MPLS over GRE)
- How one layer OAM in one segment of the network interworking with another layer OAM in another segment of the network in the same domain?
  - E.g.,E-LMI used in UNI interwork with ethernet link OAM used in 802.3 link in the same domain (See figure 2)?
- How one layer OAM interworking another layer OAM in the same segment of the network?
  - Eg.,Ethernet OAM interwork with MPLS OAM in the same segment of the network?
    - i.e., Ethernet OAM and MPLS OAM are both supported by two devices in communication.

Planned TIME Activities

- Problem Statement
  - Set out the problem statement and architecture for the Transport Independent OAM in the multi-layer network
  - and outlines the problems encountered with existing OAM protocol variety and their impact on introduction of new technologies.
- Use Case and Requirements
  - Identify and describe all the use cases that are relevant for TIME
  - requirements that we need to apply in TIME in order to identify the mechanisms, models and protocol to be worked out within TIME
- Framework and Architecture
- Gap Analysis
  - Identify technology dependent and independent component
  - analyze and understand
    - the different motivations and opportunities for optimisation of OAM in different technology networks,
    - and the trade-offs between those optimisations and
    - the overall advantage of a generic OAM mechanism.
- Develop technology independent protocol specification related to the goals in the previous slides

Where to follow TIME Activity

- The TIME mailing list was created in June 10:
  - https://www.ietf.org/mailman/listinfo/time
  - Good discussion and contributions
- A TIME BOF proposal request was sent one week before IESG and IAB
  - BOF Initially declined but IESG encouraged us to continue discussions on TIME problem space
  - Vendors and operators have shown interest in this work
  - IESG and IAB hope to see sufficient preparation and more support in community.
- The TIME BOF proposal is available at:
  - http://trac.tools.ietf.org/bof/trac/wiki/WikiStart#
- The TIME BOF Charter is not available
  - Will use BOF proposal description and some thought in these slides as baseline.
- The TIME problem statement and Use case:
  - http://tools.ietf.org/html/draft-ww-opsawg-multi-layer-oam-01.txt
  - http://tools.ietf.org/html/draft-king-opsawg-time-multi-layer-oam-use-case-00
- Candidate Solutions in management plane:
  - http://tools.ietf.org/id/draft-tissa-netmod-oam-00
  - http://www.ietf.org/id/draft-tissa-trill-yang-oam-00
  - http://tools.ietf.org/html/draft-penno-sfc-yang-01
  - http://www.ietf.org/id/draft-tissa-nvo3-yang-oam-00
- Candidate Solutions / framework/requirements in data plane:
  - http://tools.ietf.org/id/draft-jain-nvo3-overlay-oam-01
  - http://www.ietf.org/id/draft-tissa-nvo3-oam-fm-00
  - http://www.ietf.org/id/draft-kumar-nvo3-overlay-ping-01
  - http://tools.ietf.org/html/draft-aldrin-sfc-oam-framework-00
  - http://tools.ietf.org/html/draft-krishnan-sfc-oam-req-framework-00
  - http://tools.ietf.org/html/draft-jxc-sfc-fm-00
  - http://www.ietf.org/id/draft-salam-l2vpn-evpn-oam-req-frmwk-02.txt

Backup slides

ECMP Issue: Non TIME specific

- Equal Cost Multi Path (ECMP) allows
  - Protection against failures
  - Increased overall end to end BW
- Network Device typically use fields in the MAC or IP header to select the forwarding path among multiple equal cost paths
- ECMP becomes important when Network overlay, service chain technology are introduced
  - E.g., multi-instances of the same service function is invoked for a given chain to provide redundancy.
- Connectivity check and continuity check MUST follow the same path as the data traffic
  - No standard way to exercise end to end continuity and connectivity verifications that covers all of ECMP in IP worlds
  - In IP world, flow identified based on different fields in IP header(5 tuple, source port of UDP header, flow label+ src and dst add), different tunnel type has different key for the load-balancing function(e.g., GRE key in GRE, Session-ID in L2TPv3 over IP)
  - In MPLS world, flow identified based on various fields in IP header and MPLS header (5 tuple or 3 tuple in IP header, one or multiple label assigned to FEC, entropy label)
  - In Ethernet world, flow identified based on different fields In Ethernet header and IP header (src MAC+dst MAC+ VLAN or FGL, src MAC+dst MAC+ src IP+dst IP+ src/dst port, when flow entropy is supported, flow can be identified using data label+src MAC+dst MAC)
  - In SFC or NVO3 case, various tunnel protocol(e.g.,IP in IP, MAC in IP, MPLS over IP) can be supported, selecting key for load balance function can be even complicated.
  - This issue is not specific to TIME, but can we better solved this in TIME?

Constraint and Desired Goal

Assumptions

- Adopt IEEE 802.1ag CFM concept and Stick to terminologies defined in RFC6291 and RFC7276
- Honor strict OAM layering in the data plane/control plane

Requirements

- IP capability is required in the network

Non-Goal

- Working on existing OAM protocol update

Goals

- Overlay Technology Independent Multi-Layer OAM covering various heterogeneous network technologies
- Consolidate in Management plane(e.g.Using Netconf/Yang)
  - All management plane to interact with either technology dependent OAM or technology independent OAM protocol in data plane
  - Abstract OAM information common to different layer
  - Correlate OAM information in different part of network
  - Gather OAM info and provision technology independent OAM function across domain
- Consolidate in Data plane/Control plane
  - Develop technology independent OAM data plane/control plane mechanism not specific a given transport technology(e.g., Generic header, Generic TLV)
  - Allow Exchange OAM information at the layer atop of layer 3

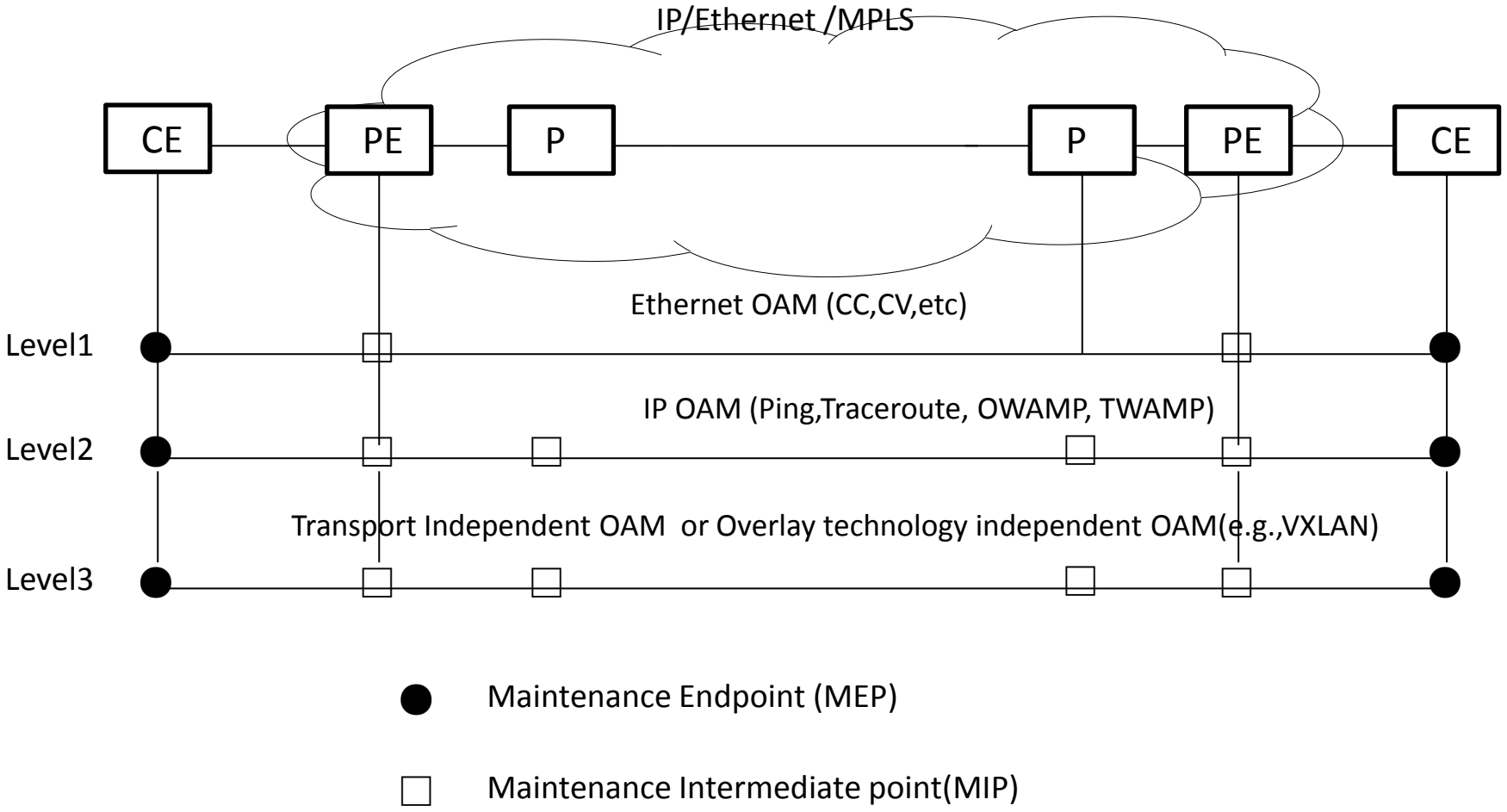
Next Step

- Develop TIME BOF Charter proposal
- BOF preparation for IETF 91 meeting
- Proposal to OPSAWG Area
  - Consolidate management plane OAM and allow management plane to manage various layer OAM in data plane across domains.
  - Abstract OAM information that are common to different layer
  - Correlate OAM information in different part of network

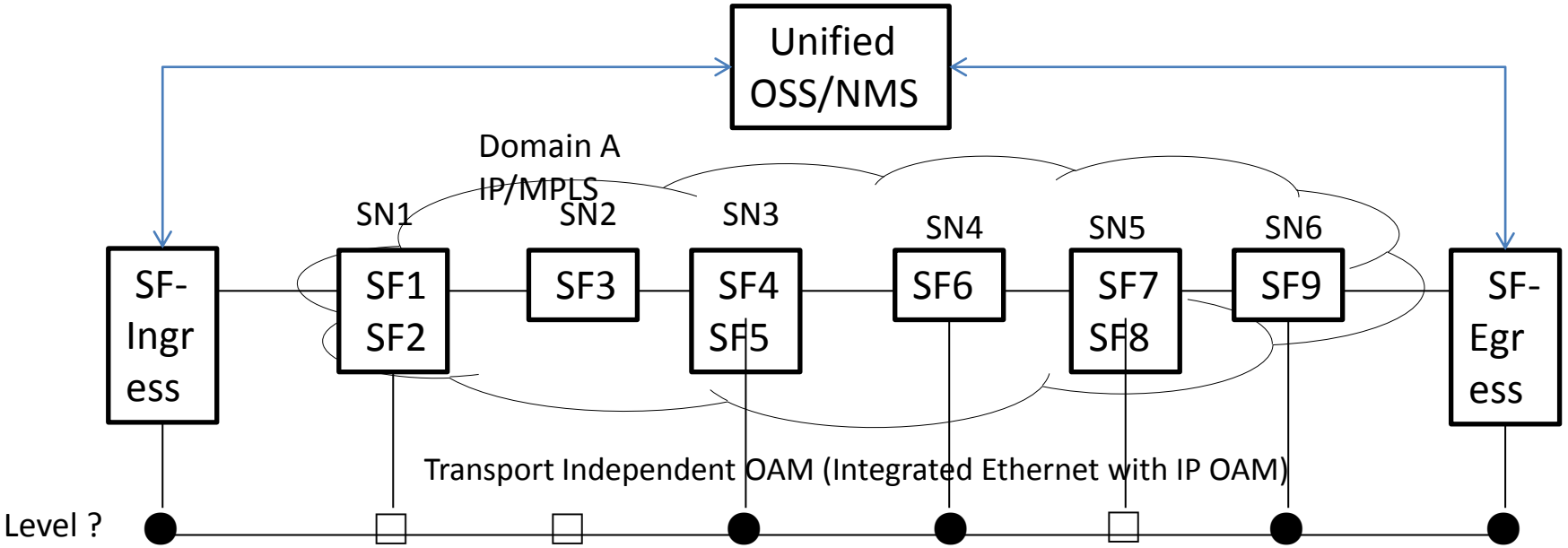
Use Case Slides

- Multi-layer and Multi-domain OAM
- Above Layer-3 OAM
- Overlay Network OAM
- Multi-Path issue in SFC OAM

Use Case1:Multiple Layer OAM



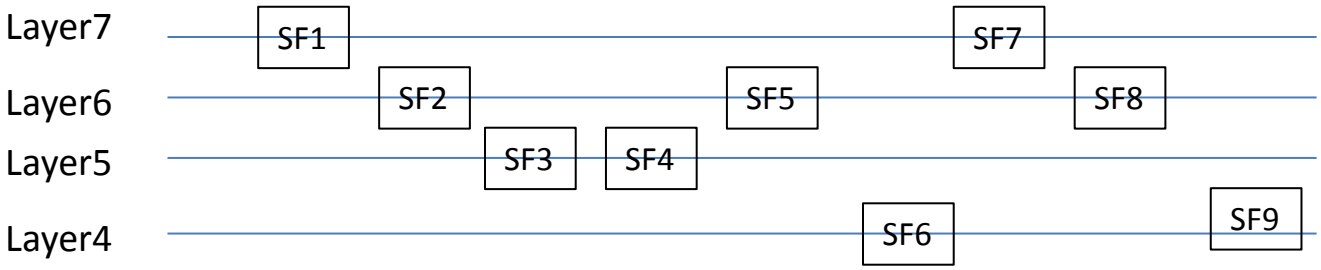
Use Case2: OAM atop of layer 3



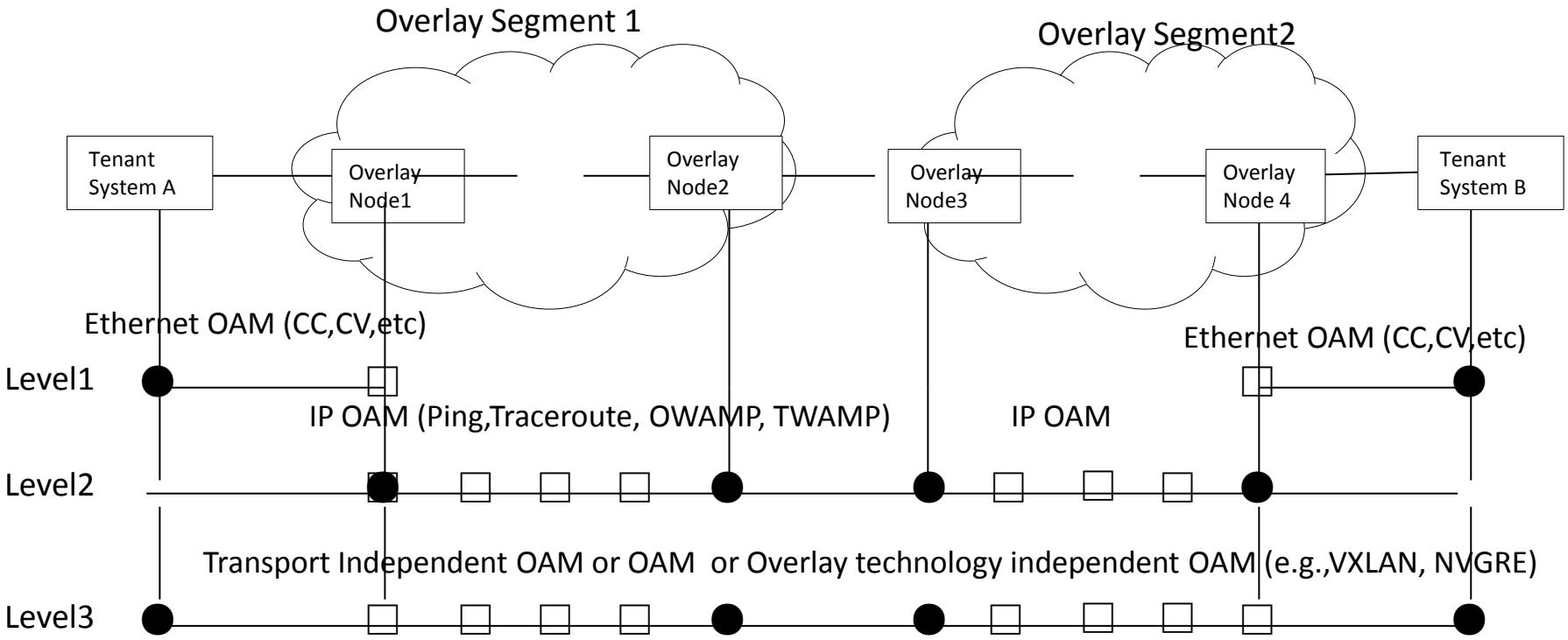
● Maintenance Endpoint (MEP)

□ Maintenance Intermediate point(MIP)

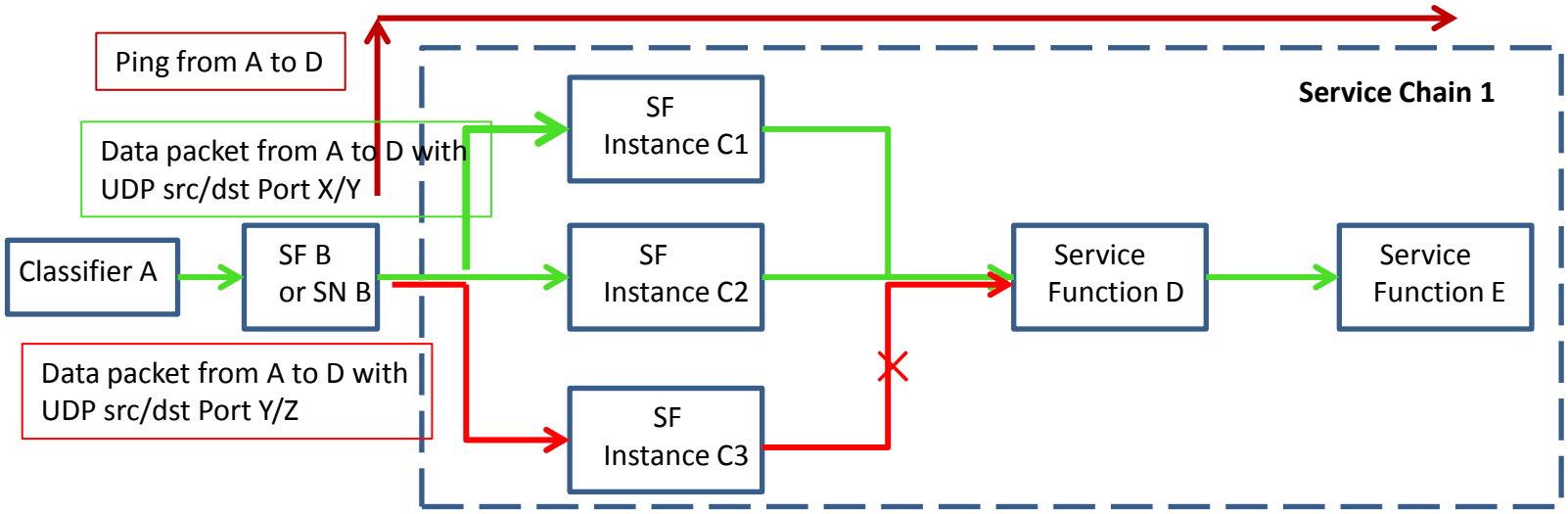
Multi-Layer OAM
Multi-Operator OAM?
Multi-Domain OAM ?



Use Case 3:Overlay OAM



Use Case 4:Multi-Path issue in SFC



SN : Service Node

- Some link(e.g., link C3-D oversubscribed that cause intermittent packet drops
- Hard to utilize end to end connectivity tools to quickly detect the failure
- Classifier A may not know how many ECMP from B
- How probe take the same path and/or return path as the normal data
- Different hash algorithm to select ECMP path
- How to describe and return multi-path information for each member link(e.g., link C3-D, link B-C3) corresponding to each SF instance